Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **30 SEP 1997**	2. REPORT TYPE	3. DATES COVERED **00-00-1997 to 00-00-1997**

4. TITLE AND SUBTITLE **Ionospheric Profiles from Ultraviolet Remote Sensing**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Alabama A & M University,Department of Physics,P. O. Box 447,Normal,AL,35762**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a REPORT **unclassified**	b ABSTRACT **unclassified**	c THIS PAGE **unclassified**	**Same as Report (SAR)**	**2**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

IONOSPHERIC PROFILES FROM ULTRAVIOLET REMOTE SENSING

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Award #: N00014-97-1-0267

LONG-TERM GOAL

The long-term goal of this project is to obtain ionospheric profiles from ultraviolet remote sensing of the ionosphere from orbiting space platforms.

SCIENTIFIC OBJECTIVES

Remote sensing of the nighttime ionosphere is a more straightforward process because of the absence of the complications brought about by daytime solar ultraviolet radiation. This, therefore, constitutes the first objective of this investigation.

APPROACH

We first focus on the reconstruction of the topside ionosphere where the major ions are O^+ and H^+. The H^+ densities are expressed in terms of O^+ densities by assuming a chemical equilibrium condition (Hanson and Ortenburger, 1961). The intensity of the O^+-e^- recombination reaction at different observation angles is then a linear combination of the altitudinal distribution of $[H][O^+]^2/[O]$. The latter can be retrieved by matrix inversion from which the densities of O^+, H^+, and e^- can be calculated sequentially.

WORK COMPLETED

A computer code to calculate the path matrix (path lengths through stratified layers at various observation angles) given the altitude of the orbiting platform, has been written. The forward model to calculate the expected nighttime emission intensities from the O^+-e^- recombination as seen from the orbiting platform has been completed.

A matrix inversion program in double precision BASIC has been incorporated. It has successfully inverted path matrices of dimensions of up to at least 29x29. Standard Chapman profiles have been reconstructed using the matrix inversion routine which are accurate up to about 1000 km.

RESULTS

The nightime intensity of the radiative recombination of O^+-e^- at 91.1 nm as observed from 833 km altitude is calculated using the forward model. The reaction rate is assumed to be 4.4×10^{-13} cm^3/s (Dymond, et al., 1995). The standard Chapman profile is given by 3 parameters: peak electron density $N_m = 10^6$ cm^{-3}; altitude of the peak $z_m = 350$ km; and atomic oxygen scale height $H = 60$ km.

Parametric study of the intensity of radiation in z_m, H and N_m are obtained for nadir angles (complements of observatrion angles) between 66 deg and 73 deg. The peak intensity nadir angle translates about 1.1 deg for every 50 km increase of z_m. There is a slight but perceptible increase in the peak intensity with z_m. The peak migrates to lower nadir angles with increasing H.

IMPACT/APPLICATION

Existing remote sensing methods for ionospheric profiles do not take into account the H^+ densities. Faithful reconstruction of the far topside ionosphere is, therefore, not feasible at present. The current study aims to rectify this situation.

TRANSITIONS

Several current and future ultraviolet remote sensing experiments to be conducted by the U. S. Naval Research Laboratory will monitor the ionosphere on a continuous basis from orbiting space platforms. The present study can find applications in these measurements.

REFERENCES

K. F. Dymond, S. E. Thonard, and R. P. McCoy, 1996. *I. E. S.* Alexandria, Virginia, May.

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